UP 519 Advanced Applications of GIS

Lecture: 2:00PM - 3:20PM, Tuesday 134 Armory

Lab: 2:00PM - 3:20PM, Thursday 101 901 W Oregon

Instructor: Dr. Fang Fang (fangf@illinois.edu)

Office Hours: 9:00-11:00am Thursday

TA: Shiva Sheikhfarshi (shivas4@illinois.edu)
Office hours: Mon 1-3 pm, TBH TA office

Course Overview:
This is the advanced GIS course for higher-level undergraduate students and graduate students. We will introduce advanced applications of many sophisticated functions of geographic information systems with some key spatial analysis concepts. Students should complete UP418 Introduction to GIS for Planners (or equivalent) as a prerequisite (Concepts and skills covered in UP 418 will not be introduced). A set of fundamental GIS principles and techniques will be introduced with hands-on lab exercises using real-world data. Topics will cover quantitative GIS techniques that are frequently used in planning and social sciences fields: spatial statistical models, image processing, spatial Interpolation etc.

This syllabus is subject to change by the instructor.

Course Outcomes:

1. Explain the theoretical and technical aspects of common spatial stats models
2. Perform basic image processing tasks
3. Apply and interpret basic spatial pattern analysis techniques
4. Specify, estimate, and interpret basic spatial regression models.
5. Select and perform a proper spatial interpolation method

Course Structure/Philosophy/Attendance

- This is a 16-week 4 credits course. Each student is expected to devote ~2 hours per week learning the lecture contents, and 1-2 hours for labs exercise per week.
- Attendance: Your full participation and presence in all classes are expected. Please contact me/TA prior to the course session which you are absent from. You get three “free” absence for the entire semester. Attendance are calculated as a percentage of number of classes attended (excluding excused absences) and scaled out of 100 points. Recordings will be available for students with excused absences prior to class. I firmly believe that students learn via engagement and by doing. As a result, this will not be a pure lecture-based course. It is important to engage yourself during this class. I will do my best to help you learn; however, it is imperative that you take ownership of your education. Feel free to email me

if you need help. The engagement is demonstrated in various ways for lectures and labs: e.g. in-class discussion, in-class exercise, in-class group work, etc. Poor attendance will not result in automatic failure, but will be reflected in the participation component of the course grade.

- All the assignments, exams, and labs are mandatory. Please contact the instructor asap for any unavoidable circumstances e.g. due to COVID-19. Excused absences, asynchronous participation etc will be granted on a case-by-case basis.
- The class time will be divided into lecture and laboratory sessions that focus on conceptual and practical topics of interest, respectively. Lab reports are due at the beginning of the subsequent class period and should be written independently. For example, lab assignment assigned on Jan 19th will be due on Jan 26th at 2:00pm.
- The first half of the semester will focus on introducing and developing the technical skills needed to work on the term project in the second half of the semester. A final project is expected at the end of the semester which will apply the geospatial data techniques for community development, environment planning, hazard planning etc. Students need to define the scope of the project and turn in the proposal around mid-semester.
- **Engagement**: I firmly believe that students learn via engagement and by doing. As a result, this will not be a pure lecture-based course. It is important to engage yourself during this class. I will do my best to help you learn; however, it is imperative that you take ownership of your education. Feel free to email me if you need help. The engagement is demonstrated in various ways for lectures & labs: e.g. in-class discussion, in-class exercise, in-class group work, in-class presentation, reading reflections, short essay summary etc. Bonus credits will be allotted for some of the in-class exercise: either essay questions for reading discussions, or mini GIS project, etc.
- Students are also expected to complete the assigned readings prior to class and to come to lectures prepared for thoughtful participation and discussion.

Textbook:

- Liu, J. G., & Mason, P. J. (2016). Image processing and GIS for remote sensing: techniques and applications. John Wiley & Sons. (Free online version available via UIUC library)

- Grekousis, G. (2020). Spatial analysis methods and practice: describe–explore–explain through GIS. Cambridge University Press. (Free online version available via UIUC library)

- All assigned readings that are not from the textbooks above have been placed on the Canvas course page

Software

Students can install ArcGIS Pro on their personal computers for free through webstore

Grading:

Grading for this class will consist of midterm exam, labs, final project and Participation & attendance.

The midterm exam (time TBD) focuses on the concepts covered in lecture and applied in the lab sessions. The exam cannot be re-taken.

Consistent with UIUC guidelines, if you cannot take a regularly scheduled exam because of authorized University activities, you will have the opportunity to take a make-up exam at an alternate time. Make-up exams for absences due to any other reason will be at the discretion of the instructor. You must notify me beforehand if you need to miss an exam. I will not let you make up an exam without prior notification.

In addition to the exams, you will be asked to complete all lab assignments, which will build on concepts from the lectures. Note the dates of these assignments in the schedule below. **Assignments must be turned in via Canvas submission. You will receive a zero on the assignment if it is not submitted.**

Attendance will be worth 50 points. This will be calculated as a percentage as the number of classes attended divided by the number of classes scaled out of 50 points. You will not be penalized for excused university absences. Other excused absences may be granted at the discretion of the instructor for e.g. COVID-19, health emergencies or in situations where religious beliefs, observances, and practices or work requirements irregularly conflict with course attendance. The first three absences will not be held against you.
Weekly reading reflections. This is an initial content engagement discussion forum. You are invited to think about what you already might know about a new idea, concept, problem or closely related concept about GIS applications in urban planning. You need first finish the readings below and submit at least one initial post and two response posts. Some suggested questions (but not limited to) will be available for you to answer. Your timely online posts and reading reflections (due on each Thursday before lab starts) in Canvas are required, which worth 100 points total (10*10). Each reading assignment is worth 10 points. Any plagiarism is found in any posts will receive a "0". Reading reflections must be submitted within 7 days after the reading is posted in Canvas.

Initial Post

Your initial post is your opportunity to engage with the prompt in a way that is unique to you. In composing your response, consider how your individual experiences influence your take on the prompt and the course material or articles covered during this module.

An acceptable initial post must meet the following requirements:

- Include at least 8 sentences, excluding any references.
- You are encouraged to 1) study with other students together 2) check out other articles of publications. However, this should never involve 1) one student having possession of a copy of all or part of posts done by someone else; 2) using or copying and pasting others' published and unpublished sentences or words and presenting them as new and original.

Grade Point Distribution:

Lab Assignments	400 Points Total (40 each)
Mid-term Exam	200 Points
Final project	250 Points
Reading discussion	100 points (10 each)
Attendance and participations	50 Points
Total	**1000 Points**

Grade Scale:

Letter grade	Percentage	Points
A+	97–100%	>970
A	93–96.99%	>930
A–	90–92.99%	>900
B+	87–89.99%	>870
B	83–86.99%	>830
B–	80–82.99%	>800
C+	77–79.99%	>770
C	73–76.99%	>730
C-	70–72.99%	>700
D+	67–69.99%	>670
D	63–66.99%	>630
D-	60–62.99%	>600
F	0–59.99%	<600

Final project:

All the students need to conduct a final project using GIS. The project can describe the role of GIS in their capstone/workshop. A project proposal is due by **March 23th 11:59pm**. A final report is required as delivery by **May 3rd 11:59pm**. The details and requirements will be posted later in Canvas.

Late submission

Assignments must be turned in via Canvas submission. You will receive a zero on the assignment if it is not submitted.

An assignment submitted 24 hours or less after the due date will only be eligible for 80% of the maximum number of points allotted. Assignments submitted more than 24 hours but less than 48 hours after the due date will only be eligible for 60% of the maximum number of points allotted, and so on. Assignments submitted **more than 120 hours (or 5 days)** after the due date **will NOT be accepted and you will receive a zero on that assignment**. If you experience extenuating circumstances (e.g., you are hospitalized) that prohibit you from submitting your assignments on time, please let me know. I will evaluate these instances on a case-by-case basis. You are responsible to confirm each submission in Canvas. **For any technical issues in Canvas/Netid, you need to contact**

me in advance or email your assignment to me ASAP by the deadline. Otherwise, the late work policy will be strictly enforced.

Error/warning messages are common in R, and these are NOT the valid excuses for late submission.

Cellphone, Tablets, and Computers:

Instructions for this course will be in in-person. Students are expected to be present during the synchronous lecture and lab hours. Cell phone use of any kind will not be tolerated.

Academic Integrity

We will follow Articles 1-401 through 1-406 of the Student Code. The provisions of the Student Code are applicable to this course. This rule defines infractions of academic integrity, which include but are not limited to cheating, fabrication, and plagiarism. You are responsible for following these guidelines. If you have any questions about whether something would be an infraction, consult with the instructor before proceeding.

Special Accommodations

We will accommodate students with documented disabilities. Please be familiar with the services and resources provided by Disability Resources and Educational Services (DRES) and visit (http://disability.illinois.edu/disability-resource-guide) for more information. Please inform the instructor of any requests at the beginning of the semester.

Run > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with almost any kind of emergency – like severe weather or if someone is trying to hurt you – we have three options: Run, hide or fight.

Feedback Response Time

I generally reply to email and discussion posts within 48 hours, except during holidays. Often I will reply much more quickly, but you should not count on a same-day reply. Please plan accordingly so that you don't miss deadlines! I generally return assignments within one week of when a discussion or assignment closes. If you would like to get help on an assignment ahead of the deadline, please email me! I'm happy to give preliminary feedback or answer questions.

Emergency Response Recommendations:

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency-preparedness/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights

and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.

Sexual Misconduct Policy and Reporting

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

Readings

1/23/2022 Week 2 Remote sensing basics

- Chapter 1 Digital image and display, Liu, J. G., & Mason, P. J. (2016). Image processing and GIS for remote sensing: techniques and applications. John Wiley & Sons.
- Li, G., & Weng, Q. (2007). Measuring the quality of life in city of Indianapolis by integration of remote sensing and census data. International Journal of Remote Sensing, 28(2), 249-267.

1/30/2022 Week 3 Aerial photo and imagery analytics

- Chapter 8 Image classification, Liu, J. G., & Mason, P. J. (2016). Image processing and GIS for remote sensing: techniques and applications. John Wiley & Sons.
- Blaschke, T., Hay, G. J., Kelly, M., Lang, S., Hofmann, P., Addink, E., ... & Tiede, D. (2014). Geographic object-based image analysis–towards a new paradigm. ISPRS journal of photogrammetry and remote sensing, 87, 180-191.
- Duwal, S., Amer, S., & Kuffer, M. (2018). Modelling urban growth in the Kathmandu Valley, Nepal. In GIS in Sustainable Urban Planning and Management (pp. 205-224). CRC Press.

2/13/2022 Week 5 Suitability modeling for continuous data

- Mishra, S., Kuffer, M., Martinez, J., & Pfeffer, K. (2018). An Exploration of Environmental Quality in the Context of Multiple Deprivations: The Case of Kalyan–Dombivli, India. In GIS in Sustainable Urban Planning and Management (pp. 45-62). CRC Press.
- Bathrellos, G. D., Skilodimou, H. D., Chousianitis, K., Youssef, A. M., & Pradhan, B. (2017). Suitability estimation for urban development using multi-hazard assessment map. Science of the total environment, 575, 119-134.

2/20/2022 Week 6 Surface and data interpolation

- Chapter 16 Extracting information from point data: Geostatistics, Liu, J. G., & Mason, P. J. (2016). Image processing and GIS for remote sensing: techniques and applications. John Wiley & Sons.
- Hsu, S., Mavrogianni, A., & Hamilton, I. (2017). Comparing spatial interpolation techniques of local urban temperature for heat-related health risk estimation in a subtropical city. Procedia engineering, 198, 354-365.

2/27/2022 Week 7 Spatial Statistics

- Chapter 4 spatial autocorrelation, Grekousis, G. (2020). Spatial analysis methods and practice: describe–explore–explain through GIS. Cambridge University Press.
- Maroko, A. R., Nash, D., & Pavilonis, B. T. (2020). COVID-19 and inequity: a comparative spatial analysis of New York City and Chicago hot spots. Journal of Urban Health, 97(4), 461-470.

3/20/2022 Week 10 Spatial-temporal dynamics

- Khorsheed, J., Zuidgeest, M., & Kuffer, M. (2018). City Morphology and Women's Perception of Travel: A Case Study for Istanbul, Turkey. In GIS in Sustainable Urban Planning and Management (pp. 141-162). CRC Press.
- Xu, Y., Fu, C., Kennedy, E., Jiang, S., & Owusu-Agyemang, S. (2018). The impact of street lights on spatial-temporal patterns of crime in Detroit, Michigan. Cities, 79, 45-52.

4/3/2022 Week 12 Overlay analysis and point pattern

- Chapter 3, Analyzing Geographic Distributions and Point Patterns, 3.3 Point Pattern Analysis Methods. P169-P179, Spatial analysis methods and practice: describe–explore–explain through GIS. Cambridge University Press.
- Brantingham, P. L., Brantingham, P. J., Vajihollahi, M., & Wuschke, K. (2009). Crime analysis at multiple scales of aggregation: A topological approach. In Putting crime in its place (pp. 87-107). Springer, New York, NY.

4/10/2022 Week 13 OLS Refresher & Spatial regression model

- 6.8 Geographically Weighted Regression P403-P409, Spatial analysis methods and practice: describe–explore–explain through GIS. Cambridge University Press.
- Freemark, Y. (2020). Upzoning Chicago: Impacts of a zoning reform on property values and housing construction. Urban Affairs Review, 56(3), 758-789.

4/17/2022 Week 14 Scripting Overview & ModelBuilder

- Ganapati, S. (2011). Uses of public participation geographic information systems applications in e‐government. Public Administration Review, 71(3), 425-434.
- Fagotto, E., & Fung, A. (2006). Empowered participation in urban governance: the Minneapolis neighborhood revitalization program. International Journal of Urban and Regional Research, 30(3), 638-655.

4/24/2022 Week 15 Introducing GIS cloud

- Drummond, W. J., & French, S. P. (2008). The future of GIS in planning: Converging technologies and diverging interests. Journal of the American Planning Association, 74(2), 161-174.
- Moreri, K., Fairbairn, D., & James, P. (2018). Issues in developing a fit for purpose system for incorporating VGI in land administration in Botswana. Land Use Policy, 77, 402-411.

Date	Week	Lecture topics	Labs
1/16/2023	1	Course Overview & Refresher Exercises	
1/23/2023	2	Remote sensing basics	Lab 1: Vegetation change detection
1/30/2023	3	Aerial photo and imagery analytics	Lab 2 : Urban land cover change for Cook county
2/6/2023	4	Term Project: Scope, Goals, & Deliverables	Term Project preps 1
2/13/2023	5	Suitability modeling for continous data	Lab 3: Use fuzzy logic for suibitability analysis
2/20/2023	6	Surface and data interpolation	Lab 4: Urban heat island detection
2/27/2023	7	Spatial Statistics	Lab 5: ESDA and spatial clustering
3/6/2023	8	Mid term exam	
3/13/2023	9	Spring break	
3/20/2023	10	Spatial-temporal dynamics	Lab 6: Emerging hot spots of crime events
3/27/2023	11	Term Project: Data Collection & Analysis Strategy	Term Project preps 2
4/3/2023	12	Overlay analysis and point pattern	Lab 7: Overlay and summarize population data
4/10/2023	13	OLS Refresher & Spatial regression model	Lab 8: Spatial modeling using demograhic features
4/17/2023	14	Scripting Overview & ModelBuilder	Lab 9: Customized GIS-based tool design
4/24/2023	15	Introducing GIS cloud	Lab 10: ArcGIS online: Web map design
5/1/2023	16	Course Wrap-Up & and term project presentation	